

NICER

Neutron star Interior Composition Explorer

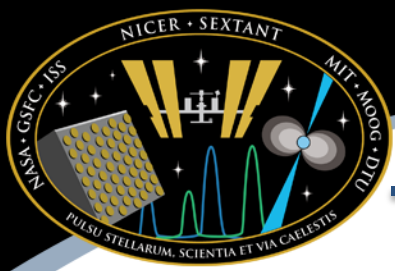
NICER Mission Overview and Lessons Learned *Keith Gendreau* NASA/GSFC



MIT KAVLI
INSTITUTE



MOOG



Agenda

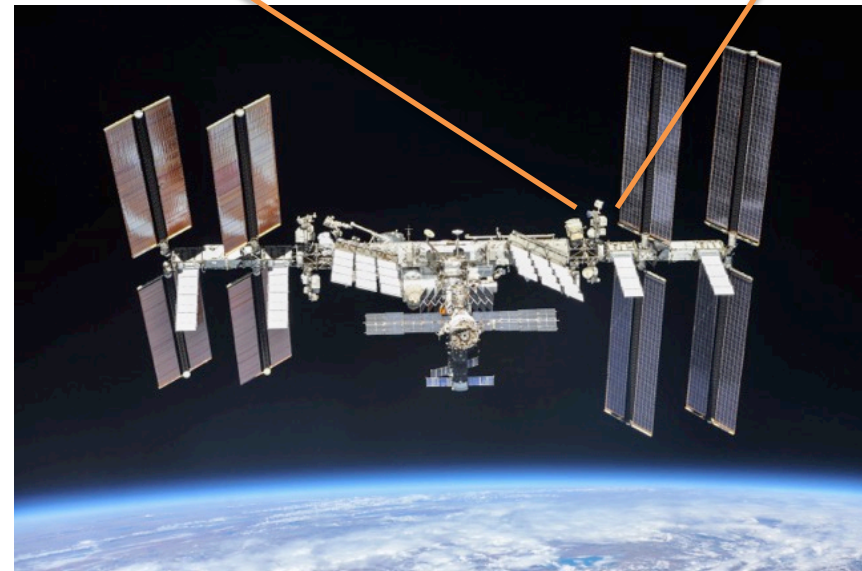
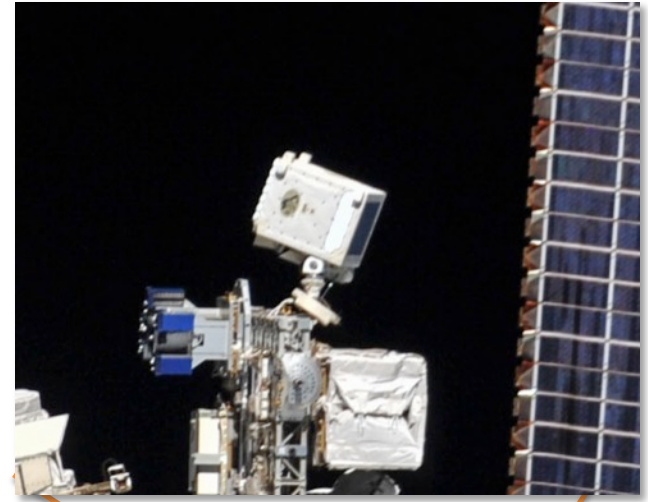
- **Mission Overview**
- **A selection of Lessons Learned with NICER**
 - **Team dynamics**
 - **Testing vs Analysis**
 - **Maintaining Schedule**



An X-ray Astrophysics Observatory on the International Space Station

Timing-spectroscopy in soft X-rays tuned to compact objects

- **PI:** Keith Gendreau (NASA/GSFC)
- **DPI:** Zaven Arzoumanian (NASA GSFC)
- **Key science:** Neutron star masses and radii to 5-10% precision
- **Launch:** 2017 June 3, SpaceX-11 resupply
- **Platform:** ExPRESS Logistics Carrier (ELC), with **active pointing** over nearly a full hemisphere
- **Instrument:** “Concentrator” X-ray (0.2–12 keV) optics and silicon-drift detectors; **GPS position & absolute time reference**
- **Status:**
 - Payload performing well
 - Successful demonstration of pulsar-based navigation
 - **Rich archive of public data**
 - Extended mission approved
 - GO Cycle 5 proposals just recieved

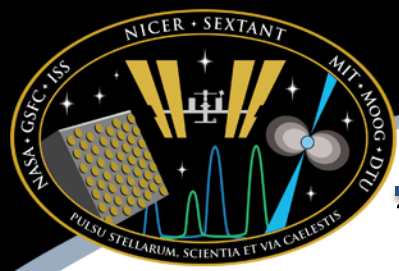




NICER in SSPF

Prior to Dragon Trunk Integration





Launch and Extraction

Time Lapse

June 3, 2017

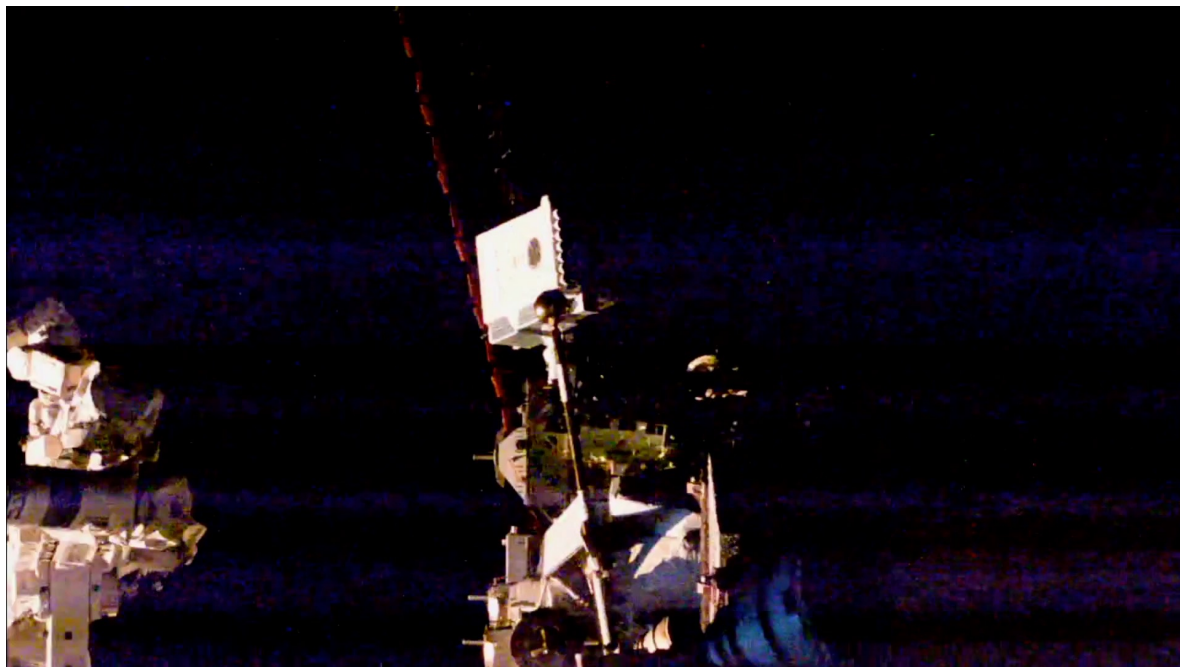
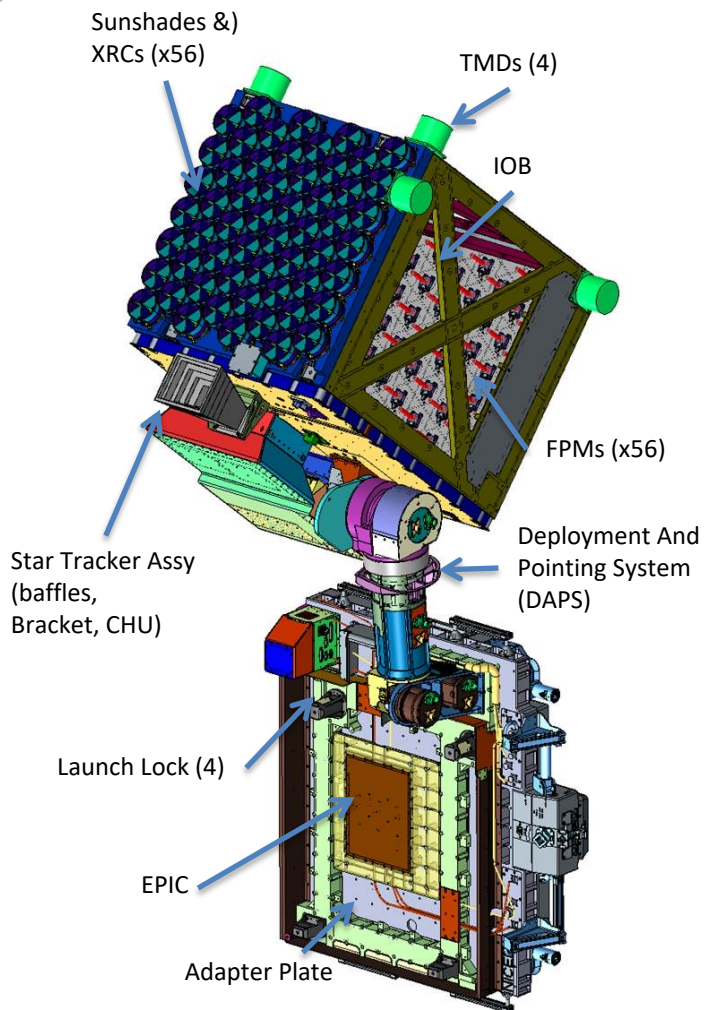


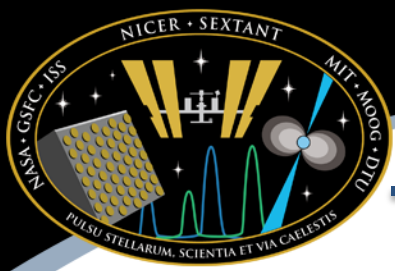
NICER in Space





The NICER Payload





NICER Team Dynamics

- **PI picks a team which has diversity**
 - **A mix of conservative people and “cowboys”**
 - **People who can get along together or the PI can bridge**
- **PI is active in ALL aspects of NICER development**
 - **PI could be a technician, manager, or resource analyst**
- **PI makes decisions very quickly**
 - **Generally in less than 1 week and sometimes immediately, but only after considering all choices and hearing all the sides**
 - **There are risks associated with most decisions- Track and manage those risks**
- **NICER focuses on mitigations to risks and healthy risk processes**
 - **Entire team is involved**
 - **Risks are actively tracked and updated monthly**
- **Team is mostly co-located when possible**
- **Major re-direction is done in person**

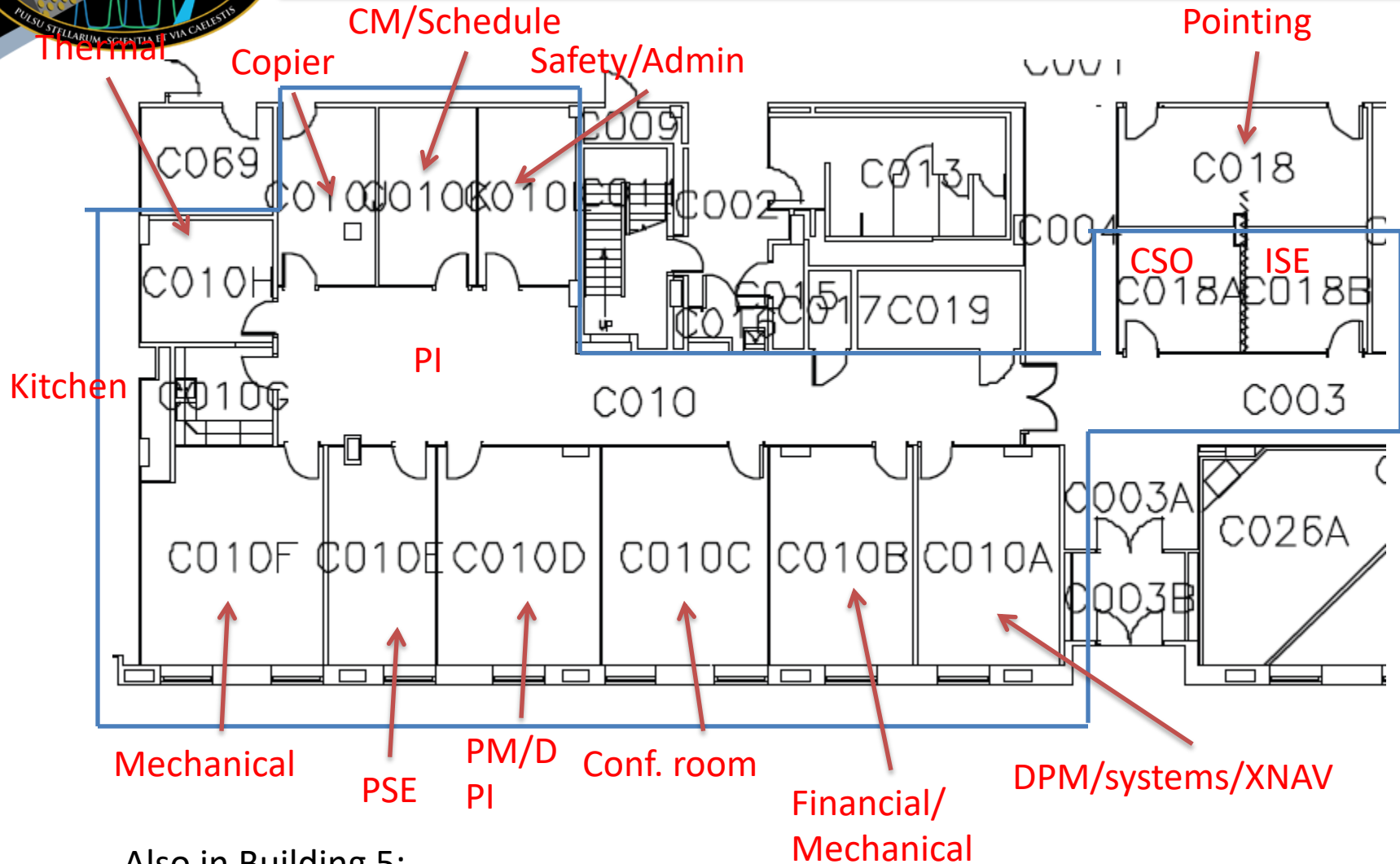


Co-Location of Core Team -> Success

- Early in Phase B, NICER was given the opportunity to co-locate all key players
 - Building 5 at GSFC is centric to most NICER labs and already had a number of thermal/mechanical/I&T personnel located there
 - Locating core team in B5 C010 and nearby offices has allowed for very clear communication
 - Minimizes misunderstandings, wasted effort
 - Reinforces “team” concept and an understanding of roles and responsibilities
- Keeps costs down and ensures success

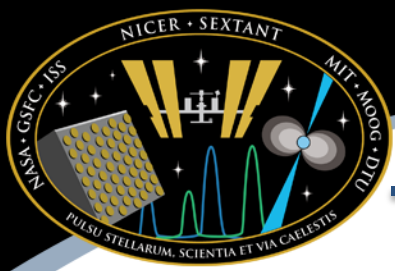


NICER HQ in Building 5: Success through Communication



Also in Building 5:

XTI Integration tent, Mechanical analyst, Thermal Analyst, Additional Mechanical Design, I&T office



Analysis versus Test

- Often the cheapest way to meet/verify a requirement is to build an Engineering model or demonstration unit using inexpensive parts and to try and demonstrate meeting the requirement
 - NICER XRC alignment and mounting system was developed this way using MANY ETUs and vibration tests
- Performing extensive analysis on things that could be built and tested is often the most expensive and can lead you wrong
 - NICER use of Frangibolts went this way and cost us dearly by moving what should have been a simple and straightforward solution to the critical path
- Iterating on the engineering model and testing should arrive at the optimum solution and highest confidence of flight build success for the least money
- Build engineering models for all difficult analytical problems



Importance of Maintaining Schedule

- **NICER strove to maintain its schedule presented in its step 1 proposal : Time is money**
 - Develop “road to PDR / CDR” plan to ensure leads understand success criteria and provide appropriate analysis, testing and documentation to pass reviews
- **Setup partnerships with all contractors in Phase A**
- **Plan extensively for long lead procurements**
- **Anticipate problems**
 - Enabled contractors to work BEFORE government shutdown
- **Be aggressive**
 - NICER held an SRR in Phase A
 - NICER presented with real ISS problem and proceeded with an aggressive plan to overcome so that mission CDR was impacted



What I wished I knew before Phase A kickoff



The importance of the core team cannot be underestimated



Backup



